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**Article — Accepted Manuscript (Postprint)**

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Theoretical and Practical Research in Economic Fields

*Suggested Citation:* Vasilev, Aleksandar (2019) : Taxation and welfare: measuring the effect of Bulgaria's 2007-08 corporate-personal income tax reforms, Theoretical and Practical Research in Economic Fields, ISSN 2068-7710, ASERS, Craiova, Iss. forthcoming

This Version is available at:
http://hdl.handle.net/10419/209683

# Taxation and welfare: measuring the effect of Bulgaria's 2007-08 corporate-personal income tax reforms

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Abstract: This paper utilizes a simple general-equilibrium model to analyse the long-run effects of Bulgaria's 2007-08 corporate-personal income tax reforms. In particular, we consider the effect working through the firm's capital structure, and argue that the new reforms incentivize firms to increase investment, as the new regime benefits retained earnings. The increase in capital increases output and productivity, which in turn increases consumption and welfare. On average, households are enjoying 8.65% higher consumption in the new steady-state in the benchmark scenario. As a robustness check, we allow for a variable labor supply, where the gain increases further by additional 3.9% of consumption, to produce an overall gain of 13.55%.

Keywords: general equilibrium tax reform, firm's capital structure, welfare gain

JEL Classification Codes: H25, H32, O41, O52

## 1. Introduction

We set up a general-equilibrium model with a detailed corporate finance sector in order to provide a quantitative assessment of the 2007-08 corporate-personal income tax reforms in Bulgaria. Starting from a rate of 32.5% in 2000, the corporate tax rate was decreased in several steps down to its current rate of 10% in 2007. Similarly, the progressive income tax schedule was flattened until a uniform rate of 10% was introduced in 2008, which is in place today as well. In addition, a dividend tax of 5% was introduced. The particular focus of the paper falls on the effect of tax changes for the cost of finance, and how that changes the firm's financial structure. Under the new regime, the firms realize certain benefits from retained earnings, which is an incentive to increase investment and accumulate physical capital. That in turn leads to expansion of output and profit. Since after tax profit is distributed to firm owners (households), consumption increases as well.

The novelty relative to Vasilev (2019) is that in this model households face an explicit utility-maximization problem, which is a function of their consumption path. This allows us to measure the welfare gain of the introduction of the two tax reforms in Bulgaria in terms of additional consumption enjoyed. The rest of the paper is organized as follows: Section 2 outlines the model. Section 3 describes the calibration procedure and presents the results from the computational experiments performed in this paper. Section 4 concludes.

## 2. The model

For the most part, the model follows closely Funke and Strulik (2006), which in turn is a general-equilibrium extension of Funke's (2002) partial-equilibrium representation. In particular, we start with a representative firm, which uses physical capital, K, and labor, L,

and combines them using a Cobb-Douglas production function to maximize intertemporal profit

$$\pi = AK^{\alpha}L^{1-\alpha} - wL - \delta K, \quad (1)$$

where A denotes total factor productivity, and $\delta$ is the *economic* depreciation rate. Note that in this paper we distinguish between economic depreciation and *accounting* depreciation, i.e. depreciation for tax purposes. In particular, following Sinn (1987), we divide tax depreciation into a part of gross investment ($I$) that is written off immediately ($z$), while the remainder ($1$-$z$) depreciates at the economic rate $\delta$. Therefore, total depreciation for tax purposes equals $z(I + \delta K) + (1 - z)\delta K = zI + \delta K$. Next, before-tax dividends are defined as follows:

$$D = \pi - I - T, \quad (2)$$

where

$$T = \tau(\pi - zI - D) \quad (3)$$

are the corporate taxes on the firm's retained earnings. Eqs. (1)-(3) then imply that dividends are then

$$D = AK^{\alpha}L^{1-\alpha} - wL - \delta K - \frac{(1-\tau z)I}{1-\tau}.$$

Next, we introduce a "tax discrimination" variable $\theta$ to capture the opportunity cost of retained earnings in terms of the net dividend foregone, e.g. King (1977), where

$$\theta = \frac{1-m}{1-\tau}, \quad (4)$$

and $m$ is the personal tax rate on dividends. Note that for $\theta < 1$, there is a preferential tax treatment of retained earnings, which will affect the financial structure of the firm and the choice of investment in particular.

The firm is assumed to maximize the discounted stream of after-tax dividends

$$V(0) = \int_0^{\infty} \theta D e^{-\int_t^v (1-m)r(s)ds}\, dv, \quad (6)$$

where the real interest rate r is taken as given by the firm. In addition, the maximization problem is subject to the following capital accumulation constraint:

$$\dot{K} = I. \quad (7)$$

Setting up a Hamiltonian, we can derive the optimality condition for the capital user cost:

$$\alpha A[\frac{K}{L}]^{\alpha-1} - \delta = \theta(1 - \tau z)r. \quad (8)$$

In other words, the net return on equity and bonds needs to be the same in order to prevent arbitrage opportunities.

Next, on the consumer side we have a representative on-member forward-looking household, which is infinitely-lived and maximized the sum of discounted utility streams, represented by

$$U = \int_0^{\infty} \frac{C^{1-\sigma}}{1-\sigma} e^{-\rho t} dt, \quad (9)$$

where C denotes consumption, $\rho$ is the time preference parameter (assumed to be constant), and $1/\sigma$ is the intertemporal elasticity of substitution for consumption.

The household financial wealth (*W*) consists of equity (*V*) and bond (*B*) holdings. The law of motion for bonds is

$$\dot{B} = (1-m)w + (1-m)rB + \theta D + Z - (1+\tau_c)C, \quad (10)$$

where Z is the lump-sum transfers from the government, and $\tau_c$ is the consumption tax rate. Together with $\dot{V}$, the law of motion for wealth becomes

$$\dot{W} = (1-m)w + (1-m)rW + Z - (1+\tau_c)C. \quad (11)$$

The first-order condition emerging from the household's constrained optimization problem is the modified Ramsey rule

$$\frac{\dot{C}}{C} = \frac{r(1-m)-\rho}{\sigma}. \quad (12)$$

Next, the government finances its expenditure G via taxes and issue of bonds ($B^G$), and its budget constraint is

$$G + rG^G = \dot{B^G} + m\left[wL + rB^G + rB + \frac{D}{(1-\tau)}\right] + \tau_c C + \tau(\pi - zI - D) \quad (13)$$

Note that government debt is "Ricardian," which means that instead of debt we can have government transfers balancing the government budget constraint, or

$$Z = m\left[wL + rB^G + rB + \frac{D}{(1-\tau)}\right] + \tau_c C + \tau(\pi - zI - D) - G \quad (14)$$

In other words, the path of government debt can be represented as a time series of government transfers. Additionally, we also assume that *G/Y=g=const*, and L=1.

National accounts then imply that

$$I = (1-g)AK^{\alpha} - C - \delta K. \quad (15)$$

Substituting this expression back into the law of motion for capital (7), and after some algebra, we can obtain

$$\frac{\dot{K}}{k} = (1-g)AK^{\alpha-1} - \frac{C}{K} - \delta, \quad (16)$$

where we have defined $c = C/K$ and $k = K/L$. We can further rewrite the equation above as

$$\frac{\dot{k}}{k} = (1-g)k^{\alpha-1} - c - \delta - 1. \quad (17)$$

Similarly, using (8), (12) could be rewritten as

$$\frac{\dot{c}}{c} = \frac{\phi(\alpha k^{\alpha-1}-\delta)-\rho}{\sigma} - 1 - \frac{\dot{k}}{k}, \quad (18)$$

where $\phi = (1-\tau)(1-\tau z)$. The two non-linear ordinary differential equations above comprise the dynamic system of the model economy, together with an initial condition for capital, as well as a boundary (transversality) condition for capital preventing non-stationary solution paths. Next, in steady-state,

$$k^* = [\frac{\sigma+\rho+\phi\delta}{\alpha\phi}]^{1/(\alpha-1)} \quad (19)$$

$$c^* = (1-g)(k^*)^{\alpha-1} - 1 - \delta \quad (20)$$

It is easy to show that $\frac{\partial\phi}{\partial\tau} < 0$ , and also that $\frac{\partial k^*}{\partial\phi} < 0$. In other words, a reduction in the corporate tax rate increases investment and steady-state capital stock. Steady-state consumption will then also increases, as consumption is a monotone function of capital.

Using the notation we introduced earlier, and holding total factor productivity level constant (*A=1*), the utility function can be expressed as follows:

$$U = \int_0^\infty \frac{(C/A)^{1-\sigma}A^{1-\sigma}e^{-\varrho t}}{1-\sigma}dt = \int_0^\infty \frac{(ck)^{1-\sigma}e^{-\varrho+(1-\sigma)}}{1-\sigma}dt, \quad (21)$$

and the equilibrium interest rate is given by $r^* = \sigma + \rho$ . Next, as in Lucas (2003) we will compute the compensatory variation as the welfare gain measured in percentage of additional consumption relative to the consumption under the old tax policy. But before we can provide a quantitative assessment of the tax reforms, we need first to assign values to all parameters in the model. We do this in the next section.

## 3. Model parameterization and calibration

We follow the tradition in modern quantitative macroeconomics, e.g. Vasilev (2105c, 2016b, 2017e) and calibrate the model in order to perform a quantitative analysis of the tax reforms through the use of a computational experiment. First, as in Vasilev (2015a), the capital share is set to its average rate in data, or $\alpha = 0.429$. Next the discount rate was set to $\varrho = 0.02$ as in Vasilev (2019). Due to the lack of data, we set $\sigma = 1.01$, as in Vasilev (2015b), which results into an approximately logarithmic specification for utility.

As in Vasilev (2017a), the capital-output ratio was set to K/Y= 3.5. Depreciation rate was estimated in Vasilev (2016) to be $\delta = 0.05$. Thus produces an investment-to-output ratio of 0.18% which is very close to that in data. Next, as in Vasilev (2017b) the value of g was set to the average government consumption-to-output in Bulgaria (0.15). The depreciation for tax purposes is $d = 0.2$, which reflects the five-year depreciation plan adopted in Bulgaria. As in Vasilev (2017d), the value added tax was set to $\tau_c = 0.2$, and the tax on wage and dividend income is $m = 0.325$ (=0.14+0.135+0.05) pre-reform, and $m = 0.281$(=0.1+0.131+0.05) post-reform. Corporate tax equals $\tau = 0.325$ pre-reform, and $\tau = 0.1$ post-reform. This in turn produces $\theta = 1$ pre-reform, and $\theta = 0.8$, post-reform, clearly benefitting investment, due to the now preferential treatment for retained earnings. Finally, as in Funke and Strulik (2006), we set z=0.72.

We then perform the computational experiment, which asks how much household's consumption under the old tax regime should go up in order to make it as well off as under the new tax regime. The quantitative analysis performed predicts a long-run consumption gain of 8.65 % between the two steady-states. As a result of the introduction of the new tax regime, capital and investment are higher by 22%, and output is higher by 9.4% as well.

One of the limitations of this analysis is that the household works all the time, and labor supply is held fixed at unity, as the household does not value leisure. As a robustness check, we therefore extend the analysis by allow for leisure in the household's utility function, which means that the households will now choose their hours of work. Following Funke and Strulik (2006), this amends the utility function to

$$U = \int_0^{\infty} \frac{(x^{\eta} C)^{1-\sigma}}{1-\sigma} e^{-\rho t} dt, \qquad (22)$$

where $L=1-x$ denotes the household's labor supply. For typical calibration value, setting η such that L=0.333 as in Vasilev (2017c). As expected, endogeneizing labor supply brings additional gains, more specifically another 3.9% towards steady-state consumption. The higher consumption gain in this scenario is due to the increase in employment (which follows directly from the complementarity between capital and labor in the Cobb-Douglas production function), which generates an increase in income and consumption, which more than compensates for the lower utility of leisure. Note that in this scenario labor income equals wL. Households increase hours worked due to the increase in wages. Labor markets are competitive and in equilibrium the wage rate equals the marginal product of labor, which in turn is increasing in capital.

## Conclusions

In this paper, we setup a dynamic general equilibrium model with fiscal policy to study the welfare effect of Bulgaria's 2007-08 corporate and personal income tax reforms. Overall, the model suggests that the tax reforms increase investment incentives, and thus bring positive effect in the long-run in the form of expanded output, and higher consumption and welfare under the new regime.

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